WildFood Project

Eating the wild: Improving the value-chain of Mediterranean Wild Food Products (WFP)

D2.2: Protocols for sustainability

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Content Table

1. Introduction and objectives

The large number of products, uses, and markets of the wild food products (WFP) leads to complex supply chains that are difficult to trace and monitor from the sources to the consumers. Innovative traceability and control systems are needed to improve quality, safety, sustainability, and due diligence at all stages of the value-chains.

D2.2. has as main objective the development and application of **protocols and innovative tools for improving the sustainability within the WFP value-chains** (e.g. acorn related products, pine nuts, truffles, aromatic plants and mushrooms).

Deliv 2.2. is coordinated by CTFC with the participation of all partners and it is based on the pilot projects implemented within WildFood project (Figure 1). First part of the deliverable comprises various protocols associated to the different pilot projects and the second part of the deliverable presents the innovations identified within those pilot projects to improve the sustainability. For example: implementing innovative techniques for introducing the circularity, low carbon, biodiversity and resource efficiency principles in the whole WFP chain (e.g. consuming less water and energy, reducing environmental impact and waste, valorising by-products, organic production, etc.).

Pilot project (coordinating partner)	**Product**	**Location**
1. Implementing a new production and transformation process for aromatic plants (INRGREF)	Rosemary and myrtle	Morneg, Ben Arous, Tunisia
2. Prediction systems for the annual supply of acorn and flour as raw material for human food products (ISA)	Acorns	Center and Southern regions, Portugal
3. Establishing mycological parks to assess and control mushrooms collection and guarantee a sustainable mycological use with appropriate mushrooms collection, while integrating social function in this activity (innovation in production and use) (CTFC)	Mushrooms	Tarragona, Spain
4. Quantifying pinecone production, with sensors and drones (CTFC)	Pine nuts	Catalonia, Spain
5. Participating in development of innovative biological agents in pest control on truffle sites/plantations (SFI)	Truffles	Ljubljana, Slovenia
6. Preparing of laboratory protocols for certification and identification of truffles (SFI)	Truffles	Ljubljana, Slovenia
7. Elaborating a production monitoring protocol for truffle (UNIPD)	Truffles	Veneto and Friuli, Italy
8. Implementing some innovation systems for production, transformation and distribution of acorn related products, namely production, transformation, packaging and distribution (ISA&HFM)	Acorns	Alentejo, Portugal

Figure 1. Pilot projects implemented in WildFood Project.

2. Protocols for sustainability

2.1. Acorns

1. ***Title of the protocol***
   Food from High Nature Value Systems (related to pilot projects 2 and 8).

2. ***Objective***
   The concept of High Nature Value farming is developed from a growing recognition that the conservation of biodiversity in Europe depends on the continuation of low-intensity farming systems. Considering this, the main objective of this protocol is to produce flour using holm and cork oak acorns from a silvopastoral system (*Montado*). This system holds a high conservation value and provides a high set of ecosystem services, thus making food production compatible with forest ecosystem conservation.

3. ***Target groups***
   Consumers, *Montado* managers, policy makers at various levels, who can help to preserve this system.

4. ***Contribution to innovation and sustainability***
   The acorns are grown in a Mediterranean climate, in a system without any irrigation, from oak trees that, besides being managed organically, have an excellent capacity to resist to climate change. As a sustainable silvo-pastoral system, this *Montado* is also home to the production of different autochthonous livestock species, in an extensive regime, that supply meat of excellent quality. As this open forest system is kept clear of shrubs by grazing animals and forest management, it maintains a high landscape quality and high biodiversity values. This allows the farmer to receive many visitors who perform outdoor activities, besides significantly reducing the number and extent of fires, characteristic of this Mediterranean climate.

   Acorn shells are used to feed the pigs, and part of these are even sold for pharmaceutical purposes. The waste from acorn flour production is also given to swine cattle, completing the production circuit.

   Acorn flour is sold nearby and also served in meals at the farm's canteen. Acorn products include acorn burgers, acorn pâté, acorn brownies, acorn coffee, fermented acorns, among other options, provided to consumers in a short supply chain concept.

   The sales based on this product are important to the farm, while also allow to provide tourist visits that are interested on acorn and acorn producing system, as *Montado* is.

   Because acorn and its use for human consumption has been gaining interest at regional, national and Iberian level, Montado do Freixo do Meio is part of the group of founders of an Iberian association, "Confraria Ibérica da Bolota", which aims to promote the production and consumption of this product as human food.

5. ***Main steps/procedures of the protocol and important aspects to implement the protocol***

2.2. Pine nuts

1. ***Title of the protocol***

   Quantifying pinecone production of *Pinus pinea* with sensors and drones (related to pilot project 4).

2. ***Objective***

   The general objective is to establish a protocol and/or tool for direct quantification of pinecone production with remote sensors that allows a quicker and more objective evaluation than the current visual procedure.

   The objective is to evaluate pinecone production in sufficient time to organize the correct collection of cones in time and space, thus increasing the efficiency of a key phase of the pinecones harvesting as it is the evaluation of annual production, and avoiding non controlled collection outside the harvest season, which brings major dangers, as the harvesting of non-mature pinecones.

3. ***Target groups***

   Forest owners, pine cones producers, pine cones pickers and buyers, forest administration, local administrations.

4. ***Contribution to innovation and sustainability***

   The pilot project innovation contributes to increase the sustainability of pinecones harvesting phase and the quality of the product.

The use of sensors allows a quicker quantification of pinecones production and allows a more sustainable harvesting from the economic, social and environmental points of view:

- Economical: better organization of the correct collection of cones in time and space, with proper harvesting techniques.
- Social: avoiding illegal collection outside the harvest season and pinecones robberies.
- Environmental: avoiding not proper harvesting techniques that can damage trees and jeopardise future pinecone production.

5. Main steps/procedures of the protocol and important aspects to implement the protocol

Within this innovation action/pilot project we have been working in the following main tasks:

1. Definition of the best differential response and the sensor needed to capture it.

2. Definition of the sample of pines to evaluate the cone production of the stand.

3. Images acquisition: high-resolution RGB images have been acquired from an unmanned aerial vehicle (UAV).

4. Image and data processing for cones estimation by means of Machine Learning: includes the processing of the images obtained by the sensors and the data obtained in the field (both, tree variables and pinecones production).

5. Results: established tools and/or protocols for direct quantification of pinecone production with remote sensors, that will allow a quicker and more objective evaluation of production than the current visual procedure.

Once the differential response has been defined and the images have been obtained, it is necessary to define the automatic processing, based on pattern recognition with manual training. Also, it is necessary to contrast the experimental estimates with reference data, which will be those established as real production, in order to evaluate the degree of accuracy and to find out possible systematic biases.

In this sense, the data collected were processed and used for the construction of artificial intelligence models for counting 1st year pinecones (flowers) from drones (UAV).

We have obtained good results for counting pinecones of the 1st year (flowers), by using high-resolution RGB images acquired from an unmanned aerial vehicle (UAV) at early stages of the crop (around May). Flowers are often overlapping in the same sector of the image. Previous works have found that there is a relation between number of flowers and number of pine cones in this species. Final product, which is a protocol and tool for direct quantification of pinecone production with remote sensors, is still in process (to be finished during next months). In any case, **some steps to implement the protocol** can already be pointed out:

- Design the flight planning, images acquisition and type of sensors (Figures 2 and 3).
- Using an artificial intelligence model, including image processing, estimates the quantity of pinecones of 1 year, from RGB images taken from a drone (Figure 4). It has a good accuracy to estimate the 1st year pinecones (more visible in the higher parts of the tree), but it is sensitive to the exact phenology of the training image.

Figure 2. Drone flight planning in *Pinus pinea* plantations.

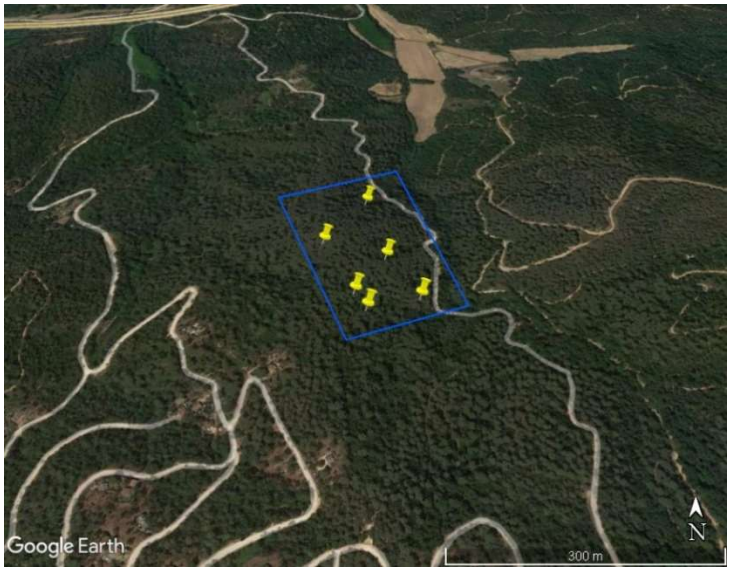


Figure 3. Drone flight planning in *Pinus pinea* natural forests.

Figure 4. Image with the labels indicating pinecones of 1 year (flowers). a) Full image with labels, b) Zoom of 2.5x, c) Zoom of 5x, d) Zoom cropping of 5x.

2.3. Truffle

1. ***Title of the protocol***
   Monitoring protocol for truffle production (related to pilot project 7).

2. ***Objective***
   Identify low-cost indicators to characterize the physiological predisposition of the plant in the establishment and maintenance of symbiotic relations with truffles, as well monitoring the effect of climatic change.

3. ***Target groups***
   *F*orest owners, forest managers and truffle farmers.

4. ***Contribution to innovation and sustainability***
   The physiology of the target trees has been investigated in relation to the surrounding environmental conditions and the level of truffle productivity in order to examinate which parameters influences more truffle production. The implementation of a low-cost monitoring station allowed to identify the key variables that enhance the production, and consequently increment the marginal utility for the forest owner or manager. We found truffle mycorrhized trees have a lower drought stress compared non-mycorrhized one, while producing truffles as source of income for the forest owner. The innovation is linked to the general understanding of the relationships between the fungus and tree and how they exchange water and sugar for re-balancing the root-soil hydraulic pressure applying a real-time monitoring station.

5. ***Main steps/procedures of the protocol and important aspects to implement the protocol***
   The procedure for monitoring truffle production it has been deeply simply during the innovation action implementation and it can be described through the following steps:
   - *a.* **Define the monitoring area** (i.e., cadastre parcel, forest management unit, etc.)
   - *b.* **Collect the main parameters** of the truffle plantation or forest such as:
     - *i.* total number of trees
     - *ii.* the trees diameters and heights
     - *iii.* the crown diameters
   - *c.* **Define the average tree of the plantation, or forest**, and select the target trees. In general, it should be selected among the trees with the average diameter, or a set of trees that represents the average tree of a given number of classes (i.e. 3 classes, 3 target trees). The more the forest structure is homogenous, the less sensors should be installed.
   - *d.* **Monitoring station installation**. The monitoring station consists of a data logger with remote control, a battery, a solar panel, one or more dendrometers, a soil humidity sensor and some meters of electric wires. The dendrometers are installed in the target trees.
   - *e.* **Set up of the databased** to store and analyse the data.
   - *f.* **Record the daily/weekly truffle harvest** and check the correct functioning of the monitoring station.
   - *g.* **Control the drought period** and the level of water stress caused to the three, in order to control the potential production within a week forecast or to regulate the irrigation in the truffle orchards.
   - *h.* **Design the local model**. The monitoring station can be better used after one year of data collection, because the data of the previous year can be used to define, if necessary, the local model (ordinary least square - OLS) that interpolate the independent variables with the daily/weekly truffle harvest.

2.4. Rosemary

1. Title of the protocol

Modification of yield and composition of rosemary essential oils by distillation and drying time (related to pilot project 1).

2. Objective

Investigate the effect of extraction time and techniques on the yield and quality of rosemary essential oils.

3. Target groups

Aromatic and medicinal plants markets and consumers.

4. Contribution to innovation and sustainability

The exploitation of aromatic and medicinal plants is a traditional activity in Tunisia. It currently represents a turnover of about 30 MTD and is an important source of income for the local population. Rosemary is one of the main species exploited on a large scale in Tunisia. It is used, either in natural form as culinary or medicinal plants, or in the form of essential oils or extracts.

Rosemary essential oils are extracted from plant material by extraction methods adapted to the specific part of the plant that contains the oils. The most common extraction methods are: steam distillation, solvent extraction, water distillation, etc. The extraction method affects the quality of the essential oil by the pressure and temperatures applied. Some extraction methods are better suited to particular types of plants and parts.

The methodology consists to monitor the quality of rosemary oils extracted by controlling the distillation time and techniques. Decreasing the distillation time for essential oils, the most relevant in economic terms, allows producers to increase their production, improve the composition of essential oils and decrease energy costs.

5. Main steps/procedures of the protocol and important aspects to implement the protocol

Figures 5 and 6 show the main factors affecting the quality and yield of rosemary essential oils and a general protocol that includes the steps of collection and transformation of rosemary into essential oils.

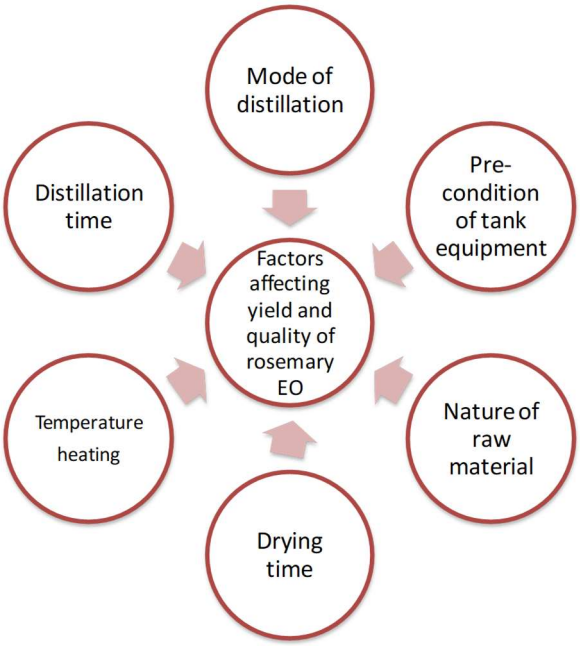


Figure 5. The main factors affecting the quality and yield of rosemary essential oils.

Figure 6. Steps of collection and transformation of rosemary into essential oils.

The first thing to do is to prepare the plant material for distillation by removing the excessively woody parts. At this position, we can reduce the size of the branches if too long, also to facilitate loading into the boiler (Figure 6a).

Most of the rosemary essential oil is produced by steam distillation. Steam distillation is the most commonly used process for extracting essential oils. Pressurized steam, make in a separate chamber, is then circulated through the plant material. The heat of the steam forces opens the tiny intercellular pockets in which the rosemary essential oil is contained releasing the oils. During steam distillation, the temperature of the steam should be moderated so that

it is high enough to open the oil pouches without destroying the plants, fracturing or burning the essential oils. The rosemary essential oil can be divided from the water by either decanting off the water or skimming off the oil from the top. The water obtained as a by-product of distillation is referred to as floral water quantity or distillate and retains many of the therapeutic properties of the plant.

2.5. Mushrooms

1. Tittle of the protocol

Social, environmental and sustainable mycological production (related to pilot project 3).

2. Objective

To generate value to the mushroom yields in the territory through the figure of a mycological park that allow to guarantee the sustainability of the resource as well as generate incomes to the local actors.

3. Target groups

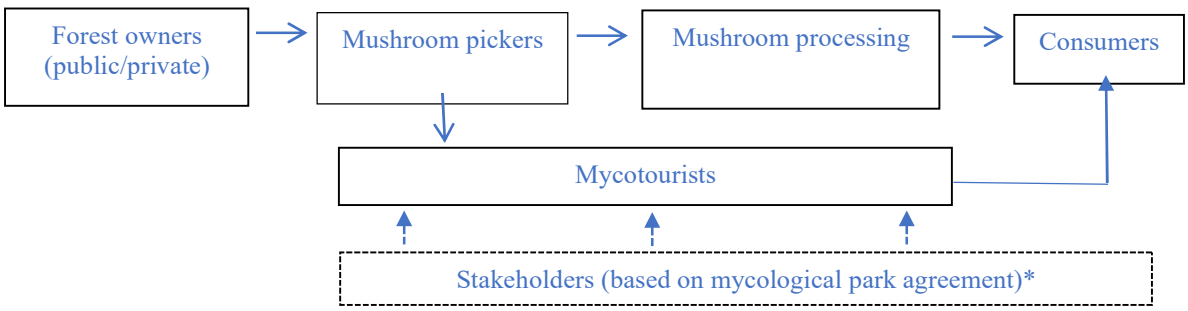
Visitors, forest managers, forest owners, tourism supply chain

4. Contribution to innovation and sustainability

Mushroom picking activity is the most popular outdoor activity in Catalonia. The fungal sporocarps that are emerging in the forests every autumn attract the attention of the people that benefit for the lack of regulation of the mushroom picking activity in the region. Consequently, the sustainability of the fungal resources can be compromised due to the overexploitation of a forest product that belongs to the land-owner according to Spanish law. Parallel to this, the current situation implies that added value of a wild mushrooms supply chain is not benefiting the inhabitants of the forest area in which the mushrooms are growing.

The mycological parks can represent an opportunity for optimizing the balance between the mycological resources conservation and the generation of added value in the area through the implementation of mycotourism models. The creation of mycological parks can be supported by the administration (in the case of the Castilla y León region in Spain they have a legal status) or just to be an internal agreement between the stakeholders in a territory that agreed in developing a sustainable touristic fungal based model. However, in Catalonian region, the mycological parks have not been implemented yet. The pilot project prospect the way to establish mycological parks in the region as an innovative tool for guaranteeing the resource sustainability while generating added value in the territory.

5. Main steps/procedures of the protocol and important aspects to implement the protocol



**Stakeholders could be mycological guides, municipalities, hotels & restaurants, mycological associations, …*

3. Innovations identified within the WildFood pilot projects to improve the sustainability

3.1. Acorns 1: innovative tools for sustainability

1. Table defining the nature of the innovative technique of the pilot project.

Partner	Pilot project		Innovative technique
(ISA)	2) Prediction systems for the annual supply of acorn and flour as raw material for human food products	X	Introducing Circularity
		X	Better productivity
		□	Low carbon emission
		□	Less water consuming
		□	Consuming less energy
		□	Reducing environmental impact & waste
		X	Valorising by-products
		□	Organic production
		□	Developing ITC
		□	Other :……

2. Innovation methodology

Despite the increase of interest regarding acorns from oak species, there is a limited number of studies and data regarding acorn yield in Portugal, and those existing are mainly focused on *Quercus rotundifolia* in the Alentejo region. Data collection, research, and the development of prediction tools for acorn yield is crucial for developing a sustainable acorn economic row. Having in mind the context of circular economy, the importance of utilizing sub products is a concern nowadays. Regarding acorns, the usage of cupules and fruit wall (pericarp) for bioactive compounds might be of interest and has never been carried out.

The methodology we apply for collecting data specifies separately: yield from acorn for human consumption, yield from acorn not suitable for human consumption, acorn cupule yield and proportions of the previous. We will review and develop predictive models for estimating acorn and cupule productions of *Quercus suber* and *Quercus rotundifolia* in Portuguese regions. We also intend to optimize drying conditions for acorn raw material under controlled environments, namely under distinct temperatures, by the development of drying curves suited to this specific wild food product. The data gathered will allow to increase knowledge regarding the main drivers for acorn production, provide new tools that forest managers and forestry services can apply in the development of forest management tools and economic plans that integrate acorn production, as well as to raise interest in the potential usage of acorns for human consumption.

✓ **What is the impact of innovation for improving the value chain?**

The innovation will allow to better access the products availability through the application of improved prediction models. This will allow to better direct the product flow and give new uses to an often underexploited and undervalued product.

✓ **What are the target sectors affected by innovation?**

Forestry sector and food industries.

✓ **Identify the target stakeholders that the innovation affects or that are beneficiaries of:**
Forest managers, forest advisory services, forestry services, food industry.

✓ **Is there any potential market for the innovation?**
No.

✓ **Does the innovation benefit from intellectual protection?**
No.

✓ **If yes, define it:**

□ Patent; □ homologation; □ Protocol

- □ National Innovation;
- □ International Innovation.
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✓ **Does the innovation benefit from a commercial outlet?**

X National Market
□ Regional Market
□ International Market

3.2. Acorns 2: innovative tools for sustainability

1. Table defining the nature of the innovative technique of the pilot project.

Partner	Pilot project		Innovative technique
(ISA&HFM)	8) Implementing some innovation systems for production, transformation and distribution of acorn related products and AP, namely production, transformation, packaging and distribution	□	Introducing Circularity
		X	Better productivity
		□	Low carbon emission
		□	Less water consuming
		X	Consuming less energy
		X	Reducing environmental impact & waste
		□	Valorising by-products
		□	Organic production
		□	Developing ITC
		□	Other :……

2. Innovation methodology

3.

The methodologies being that we intend to experiment are to improve the production of acorns (more efficient and less labour need in the harvesting process and predictability of the amount of raw material) and in 3 parts of the processing process (drying, peeling and griding). Drying include innovations on the sources of heat that dry the acorns and develop distinct drying curves. Peeling includes innovations on how can we lower the need in labor and the quality of the process (less pieces of shells). Regarding the griding we can test different mills we have an check efficiency and quality of the final product. Finding the optimal humidity content to help the griding process. Considering trying to outsource this process and compare costs/benefits.

✓ **What is the impact of innovation for improving the value chain?**
We can add a lot of value by reducing costs of labor and have more competitive prices of the final products.

✓ **What are the target sectors affected by innovation?**
Sector of production and processing acorns which indirectly will affect marketing and commercial sectors.

✓ **Identify the target stakeholders that the innovation affects or that are beneficiaries of:**
Farmers, processers, distributors and sellers.

✓ **Is there any potential market for the innovation?** Yes.

✓ **Does the innovation benefit from intellectual protection?** No.

✓ **If yes, define it:**

□ Patent; □ homologation; □ Protocol

- □ National Innovation
- □ International Innovation.
-

✓ **Does the innovation benefit from a commercial outlet?**

X National Market; X Regional Market; X International Market

3.3. Pine nuts: innovative tools for sustainability

1. Table defining the nature of the innovative technique of the pilot project.

Partner	Pilot project		Innovative technique
(CTFC)	4) Quantifying pinecone production, through the use of sensors and drones (pilot site, Catalonia). The objective is to evaluate pine cone production in sufficient time to organize the correct collection of cones in time and space, thus avoiding collection outside the harvest season and manually, which brings major dangers.	☐	Introducing Circularity
		×	Better productivity
		☐	Low carbon emission
		☐	Less water consuming
		☐	Consuming less energy
		☐	Reducing environmental impact & waste
		☐	Valorising by-products
		☐	Organic production
		☐	Developing ITC
		☐	Other :……

2. Innovation methodology

The edible pine nut of the stone pine (*Pinus pinea* L.) constitutes, due to its high nutritional value, excellent flavor and connection to the Mediterranean diet, one of the most emblematic WFP's of the Mediterranean forests, with an important impact on the world market (Calama *et al*., 2020). However, cone production is highly variable between trees and years, making it difficult to predict annual production and consequently to organize the harvesting of the pinecones, from which the pine nuts will be obtained. In this sense, it is very common that forest owners (private or public) do not know the production of their forests or plantations and are not able to organize the correct collection of cones in time and space, with proper harvesting techniques, avoiding collection outside the harvest season or pinecones robberies.

The innovation presented in this pilot project is related to the establishment and provision of new technologies and protocols for directly quantifying pinecone production, using drones and multispectral sensors, to develop more efficient and precise evaluation of pine cones than the current visual pinecone estimation. The idea for improvement is the use of remote sensors to estimate pine productivity for a sufficient number of trees in a systematic way for the same extrapolation or even to partially count the pinecones directly and estimate productivity for every tree in a whole forest. The development and evaluation of the methodologies by using remote sensors are carried out on pilot plots.

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✓ **What is the impact of innovation for improving the value chain?**

The correct estimation of pinecone production, both, at tree and stand level, is crucial in pine nut value chain. For example:

- Pine forests owners (private or public) can know the potential value of the annual harvesting, which allow them to organize the correct collection of cones in time and space, with proper harvesting techniques, avoiding collection outside the harvest season or pinecones robberies, also help them to negotiate the conditions for the pine cones sale or collection subcontracting
- Companies can know more precisely the total production and proximately value for an specific forest area and to plan the most profitable method of harvesting (estimate the needs for mobilizing machinery and human resources for a campaign).

- Processing companies will be able to plan the processing, commercialization and marketing campaigns with less uncertainty.

✓ **What are the target sectors affected by innovation?**

Pinus pinea forest and plantation owners and managers, pine-cone producers, pickers and companies involved in the harvesting and processing of the pine-cones.

✓ **Identify the target stakeholders that the innovation affects or that are beneficiaries of:**

Forest owners associations, forest managers and forest administration, municipalities that own forests.

✓ **Is there any potential market for the innovation?**

Could be, depending on the final product. At the midterm, the innovation could fetch a price in the market as a new technology for estimating tree-fruit production.

✓ **Does the innovation benefit from intellectual protection?**

Could be, depending on the final product. At the moment, the methods and protocols used are based on public knowledge and planned as open source software. New software and algorithms developed in the future could be protected by copyright or patented.

✓ **If yes, define it:**

□ Patent; □ homologation; X Protocol

- □ National Innovation ;
- □ International Innovation.

✓ **Does the innovation benefit from a commercial outlet?**

□ National Market
□ Regional Market
X International Market

3.4. Truffles: innovative tools for sustainability

1. Table defining the nature of the innovative technique of the pilot project:

Partner	Pilot project		Innovative technique
(UNIPD)	7) Elaborating a production monitoring protocol for truffle	□	Introducing Circularity
		X	Better productivity
		□	Low carbon emission
		X	Less water consuming
		□	Consuming less energy
		□	Reducing environmental impact & waste
		X	Valorising by-products
		X	Organic production
		□	Developing ITC
		□	Other :……

2. Innovation methodology

Traditional monitoring systems for truffle orchard consider soil characteristics, precipitation and temperatures. However, they don't take into account the importance of the physiological status of the host plant, which is the only organisms who can actually feed the truffle. Our innovation idea is to monitor physiological parameters of the plants to understand the mechanisms through which the roots release sugars for the truffle. To do this, we use some sensors, such as dendrometers, sapflow sensors and environmental sensors.

Dendrometers measure the continuous variation of the stem diameter, accounting for the actual growth, but also for the bark shrinking and swelling following the tissue dehydration and rehydration, respectively. The sapflow sensors allow the continuous measurement of the rate of the sap flowing along the stem during the whole growing season. We installed these sensors on productive plants and non-productive plants, to highlight the difference between the two groups and to characterize the physiological predisposition of the plant in the establishment and maintenance of symbiotic relations with truffles. We also installed environmental sensors, to measure relative air humidity, air temperature, precipitations, but also soil parameters (soil temperature and humidity). All measures are taken at an interval of 15 minutes. Knowing the real status of the plant it's possible to choose the best treatment to control and enhance the production. For example, through monitoring it is possible to identify a threshold below which productivity collapses. In this way it is possible to irrigate only when the situation becomes risky, thus allowing to save water.

✓ **What is the impact of innovation for improving the value chain?**

The innovation could increase the production, offer sustainable management and help to reduce management costs.

✓ **What are the target sectors affected by innovation?**

Forestry, agriculture, truffle market (pickers, restaurants, consumers)

✓ **Identify the target stakeholders that the innovation affects or that are beneficiaries of:**

Forest managers, policy makers, owners of truffle orchard, consumers.

✓ **Is there any potential market for the innovation?**

Yes, especially in the areas where the productivity of forests is affected by climate change and land abandonment.

✓ **Does the innovation benefit from intellectual protection?**

No.

✓ **If yes, define it:**

□ Patent; □ homologation; □ Protocol

- □ National Innovation ;
- □ International Innovation.

✓ **Does the innovation benefit from a commercial outlet?**

X National Market

□ Regional Market

□ International Market

3.5. Mushrooms: innovative tools for sustainability

1. Table defining the nature of the innovative technique of the pilot project.

Partner	Pilot project		Innovative technique
(CTFC)	3) Establishing mycological parks (Tarragona, Spain), to assess and control mushrooms collection and guarantee a sustainable mycological use with appropriate mushrooms collection, while integrating social function in this activity (innovation in production and use).	□	Introducing Circularity
		□	Better productivity
		□	Low carbon emission
		□	Less water consuming
		□	Consuming less energy
		□	Reducing environmental impact & waste
		X	Valorising by-products
		□	Organic production
		□	Developing ITC
		□	Other :……

2. Innovation methodology

Mushrooms is the most popular Wild Product in Catalonia where it is estimated that more than 15% of the population picks mushrooms at least once a year. The motivation for mushroom pickers far exceeds the economic value of the collected edible fungi, increasingly seeking a recreational, close to nature activity. This activity has been named mycotourism and tries to connect the fungal discovery with gastronomy and fungal related tourism activities. Parallel to this, the figure of mycological parks has appeared. Mycological parks are areas in which the managers try to combine mushroom productivity, fungal conservation and the promotion of mycotourism.

However, there is still no specific agreed rules on how the mycological parks can be created, supported and monitored in Catalonia. The objective of this pilot project is to establish the basis for the creation of a mycological park, aiming to make compatible mushroom picking with fungal conservation and the development of mycotourism. The methodology to introduce such innovation will be based on the evaluation of mushroom yields through weekly inventories of the fungal fruitbodies in permanent mushroom plots established in the pilot area "PNIN of Poblet". The inventory will allow us to have an approximation of the quantity and diversity of the fungal community. In parallel, we will list the mycotourism facilities in the surrounding area that will be benefited by mushroom related activities. The combination of mycotourism facilities with the mushroom species catalogue, will optimize the different mushroom related services that will be offered in the mycological parks.

✓ **What is the impact of innovation for improving the value chain?**

The innovation can allow to enlarge the wild mushrooms value chain introducing the mycotourism activities.

✓ **What are the target sectors affected by innovation?**

Tertiary services such as tourist facilities, bars or restaurants will benefit from innovation, but also the conservation of the forest area through the sustainable management of the mycological resources.

✓ **Identify the target stakeholders that the innovation affects or that are beneficiaries of:**

Forest managers, Policymakers, tourism operators.

✓ **Is there any potential market for the innovation?**

In the long term, the introduced innovation could generate a quality label for mycological resources.

✓ **Does the innovation benefit from intellectual protection?**

No.

✓ **If yes, define it:**

□ Patent; □ homologation; □ Protocol

- □ National Innovation;
- □ International Innovation.

✓ **Does the innovation benefit from a commercial outlet?**

□ National Market

X Regional Market

□ International Market

The Partnership for Research and Innovation in the Mediterranean Area will devise new R&I approaches to improve water availability and sustainable agriculture production in a region heavily distressed by climate change, urbanisation and population growth.

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